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Solar Based Voice Control Vehicle Using MIT

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ABSTRACT

The role of robotics in both commercial and residential applications has become increasingly vital, simplifying complex tasks for greater convenience. Extensive research is being conducted to enhance the interaction between humans and robots. This paper explores the design and development of a voice-controlled talking robot operated via a mobile phone, utilizing an Arduino Uno microcontroller. The robot's movement will be controlled through voice commands, and it will respond to the user with human-like speech for each given instruction. The proposed system integrates a microcontroller connected to an Android smartphone via a Bluetooth module to receive voice commands. The smartphone application will convert spoken commands into text and transmit the corresponding data to the microcontroller, enabling precise robot movement based on the received instructions. The evaluations further explore the practicality and limitations of solar- powered electric vehicles, as well as challenges encountered in real-world autonomous driving. Ultimately, this project offers insights into combining renewable energy and autonomous features in VC cars, with broader applications for real-world electric vehicles.

Keywords: Solar-panels, Bo motors, L293d motor driver, Bluetooth, Batterie’s, Arduino uno, Chassis, Mobile Phone

1. INTRODUCTION

The rapid development of renewable energy sources and autonomous systems has transformed various sectors, notably the automotive industry. This paper offers a comprehensive analysis of two distinct prototypes: a solar-powered, Bluetooth-controlled VC car and an autonomous model VC car. It enables a machine to interpret and execute verbal commands, facilitating seamless communication. Transmitting information or instructions through speech is a natural interaction method, and ongoing research in speech and voice recognition continues to advance this technology. In this project, we have designed a system to control the movement of a vehicle using voice commands from the user. These commands are issued through an Android application on the user’s smartphone, which communicates with the robot via a Bluetooth module. The entire system is powered by a 12V rechargeable battery mounted on the vehicle. The primary objective of the voice-controlled vehicle is to recognize, interpret, and execute the user's spoken instructions efficiently.

The primary goal of this study is to design and build an VC car powered by solar energy, operated remotely through a Bluetooth-enabled Android application. This approach not only promotes renewable energy usage but also offers a platform for understanding solar power generation and consumption in small-scale electric vehicles. Additionally, this research explores autonomous navigation by equipping the VC car with object detection capabilities, allowing it to avoid obstacles through automated maneuvers. This aspect enhances the car's functionality and provides insights into the challenges facing autonomous systems, such as false negative detections from sensors. The study also examines limitations affecting solar panel efficiency, a crucial factor for the solar powered RC car. By extrapolating from the RC model, this research aims to offer insights into the potential challenges and advantages of incorporating solar power in full-sized electric vehicles.

ADVANATGES

It is controlled using mobile app which is transceiver through Bluetooth module

and has LAN coverage.

➢ Can be used for collecting information of the surrounding in defense line.

➢ Solar panels can be installed to use as a source of energy to operate the device

and hence it can prove to be eco-friendly.

➢ It can capture images if we install a camera after further modifications made. The

images captured can be informative in the defense line, and can spread awareness

about the enemies.

➢ Toxic gas sensors can be used to detect the toxic gasses found in mining areas where it is injurious and deadly for human beings to go.

- We can control through remotely and voice via mobile phone without a drive.

DISADVANATAGES

➢ It's can be used while sunlight is present when batteries was dis-charged.

➢ It can be controlling shorter distance.

➢ We can give clear instructions through ours voice the google assistance can recognition different words and spellings.

2. LITERATURE SURVEY

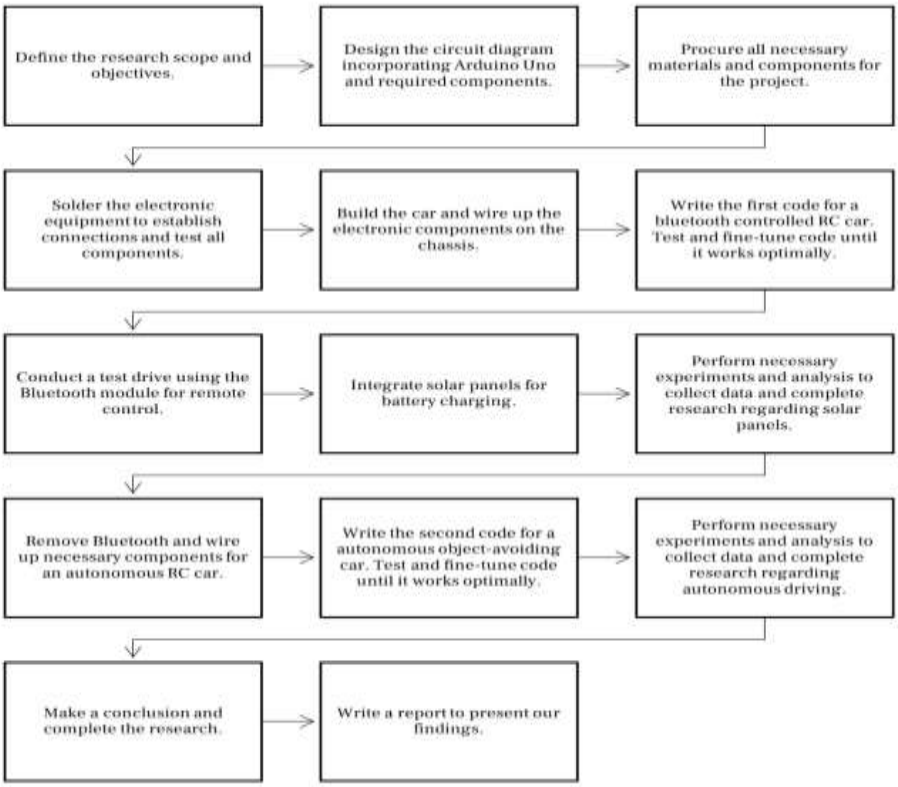
This literature review examines recent advancements in independent systems, with a focus on solar charged, Bluetooth- controlled RC buses and independent RC models using Arduino. The review explores the integration of renewable energy, similar as solar power, in small- scale electric vehicles and the use of Bluetooth technology for remote control via Android operations. It references studies like those by Munauwar and Rosnah Mohd Zin, who developed a Bluetooth- controlled robot auto for food delivery in caffs , and the work of Md. Mahmud Hasan, Md. Hafizur Rahman Masum, and Kantish Roy Chowdhury, who successfully erected and tested a Bluetooth- controlled independent auto[1].

The paper " Autonomous Car using Arduino " by Shambhavi Lalsinge, Yash Mali, Akshit Mahale, Mrunmayee Kulkarni, Omkar Kurade, and Professor Pramod Patil presents a model for a tone- driving auto using Arduino factors. This design includes an Arduino Uno microcontroller, servo motors, a motor motorist circuit, gear motors, and an ultrasonic detector. The detector detects obstacles, and the Arduino processes the data to control the motors, steering the auto consequently. In the paper " Arduino- Grounded Robot Car for Returning Food Orders " by Ahmad Amir Fahmi Ahmad Munauwar and Rosnah Mohd Zin, the authors designed and erected an Arduino- grounded, Bluetooth controlled robot auto to grease contactless food delivery in small caffs during the COVID- 19 epidemic. The auto could be operated ever via smartphone within a 30- cadence range and could carry food orders importing 350 – 400 grams[2].

The authors concluded that this design effectively reduced face- to- face commerce in eatery settings. In the paper" Bluetooth Controlled Arduino Based Autonomous Car" by Md. Mahmud Hasan, Md. Hafizur Rahman Masum, and Kantish Roy Chowdhury, the authors developed and erected a prototype of an independent auto that can be controlled via a mobile app using Bluetooth communication[.5]

The design incorporates an Arduino Uno microcontroller, an HC- 05 Bluetooth module, an L298N motor motorist, DC motors, and an Android smartphone with a custom control app. The authors successfully tested the auto's unidirectional control through the smartphone app over Bluetooth, achieving a range of roughly 4 km with minimum connection issues. They conclude that Bluetooth is a feasible communication system for analogous systems, with promising implicit operations[6].

3. Methodology and System Design



4. METHODOLOGY & MODELLING

In the current study, the following tackle & software factors are used to apply the conduct of the SOLAR BASED VOICECONTROL VEHICLE SIGN MIT.

• Solar panels

• Bo motors

• L293d motor motorist

• Bluetooth

• Batteries'

• Arduino UNO

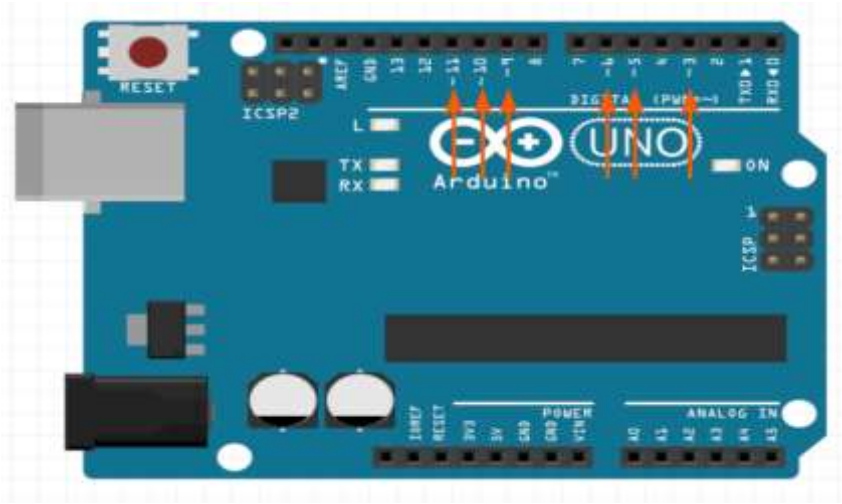
• Chassis

• Mobile Phone

Software Used

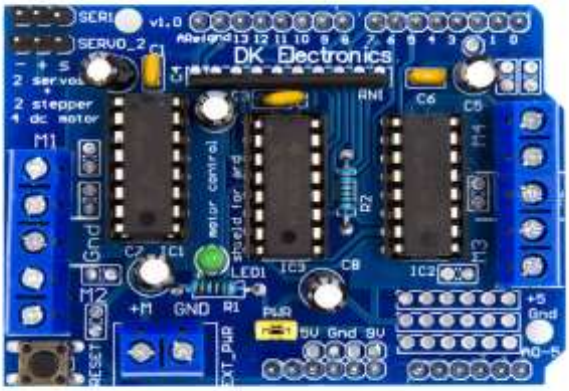
• Arduino UNO

Arduino UNO IDE Arduino UNO The Arduino UNO is a popular, easy- to- use microcontroller board grounded on the ATmega328P microchip. It's generally used for electronics systems and prototyping due to its simplicity, inflexibility, and expansive community support. Developed as part of the open-source Arduino platform, the UNO allows druggies to produce a wide range of systems, from simple LED blinkers to complex robotics and colonization systems.



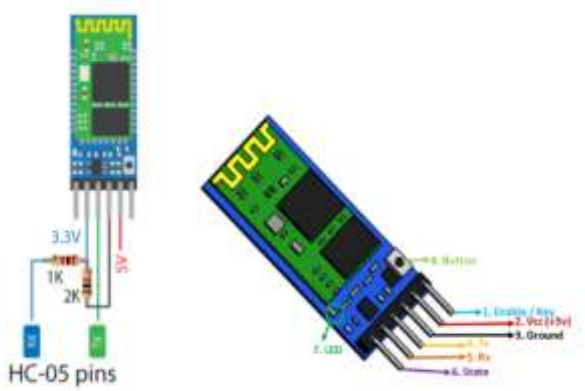
Arduino uno board

Motor Driver: Motor Motorist Motor motorist is a module for motors that allows you can control the bus speed and direction of two motors contemporaneously.. This Motor Driver is designed and developed based on L293D. This is designed to provide directional drive currents at voltages from 5 V to 16 V.



L293d Motor shield

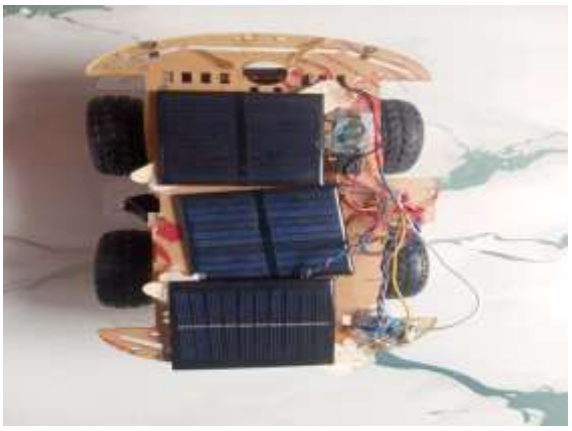
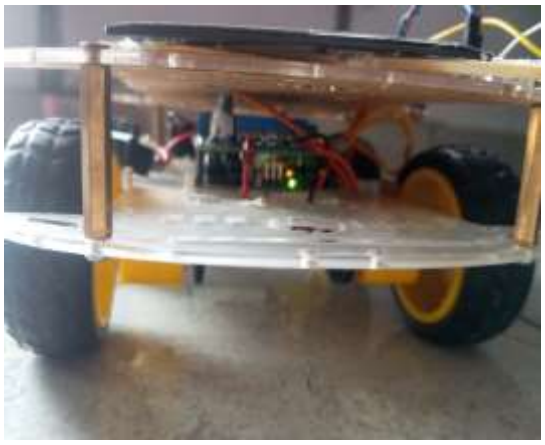
HC-05 Bluetooth Module: A Bluetooth module is a small device that enables wireless communication between electronic devices over short distances, typically up to about 10 meters. In the context of projects with microcontrollers like the Arduino, Bluetooth modules allow a device to communicate with smart phones, tablets, computers, or other Bluetooth-enabled devices without physical connections. One of the most commonly used Bluetooth modules for Arduino projects is the HC-05 module.



Bluetooth module

5. Working Principles and System Design

A solar panel harnesses sun and converts it directly into electrical energy using a photovoltaic(PV) device, operating through a process known as the photovoltaic effect. These panels are composed of numerous solar cells, generally made from photovoltaic paraphernalia analogous as liquid silicon, arranged in a series configuration. When sun hits the face of these solar cells, it generates an electric current. Each solar cell features two layers of semiconductor material. In our study, the 9V solar panel used silicon as its primary photovoltaic substance. One caste is unraveled with boron, a Group 13 element with three valence electrons, introducing" holes" positive charge carriers into the demitasse clear structure. This forms p- type silicon. The other caste is unraveled with phosphorus, a Group 15 element with five valence electrons, which contributes spare electrons — negative charge carriers performing in n- type silicon. The difference in valence electrons between silicon and the do pants creates an imbalance, giving rise to the flux of charge when exposed to light. Silicon, naturally a semiconductor with four valence electrons, forms a stable lattice through covalent cleave. Answer with boron or phosphorus alters the charge balance, easing conductivity. When sun strikes the cell, photons are absorbed, provocative electrons and enabling them to break free from their atomic bonds — this commerce is part of the photoelectric effect and leads to the conformation of electron-hole couples. The band gap, defined as the energy difference between the valence and conduction bands, determines how important energy is demanded for an electron to jump into the conduction band.Photons with energy above this threshold can excite electrons into the conduction band, leaving behind holes in the valence band. At the junction of the p- type and n- type layers, an electric field is established. This field drives the electrons toward the n- type caste and holes toward the p- type caste, preventing recombination. substance connections on each caste collect the engaged charges, allowing current to flux through an external circuit. In the 9V panel used in our trial, multiple cells are connected in series to achieve a total affair voltage of 9 volts. For optimal performance, the solar panel needs to operate at a specific weight resistance, known as the maximum PowerPoint, where the product of voltage and current is maximized. To achieve this, we employed a CN- 3791 solar charge controller featuring Maximum PowerPoint Tracking(MPPT) technology, which roundly adjusts the operating point to ensure effective energy transfer, especially useful for charging operations..

	
POWER GENERATION	WORKING

This MPPT function ensures the solar panel operates at its optimal PowerPoint, maximizing energy transfer. Working Principle of MPPT Circuits in CN- 3791 The CN- 3791, like utmost Maximum PowerPoint Tracking(MPPT) circuits, uses an anxiety and observation system to identify the solar panel's maximum PowerPoint. This fashion involves periodically conforming the panel’s operating voltage and observing the performing power affair. In the CN- 3791, a small ripple voltage is applied to the DC/ DC motor, and the motor’s duty cycle is varied to change the input voltage from the panel. The circuit also measures both current and voltage to calculate the panel's power output.However, the circuit continues conforming in the same direction, If the power increases. still, it reverses the adaptation direction, If the power decreases. This cycle of adaptation, dimension, and correction is continuously repeated by the CN- 3791’s microcontroller to track the maximum PowerPoint, conforming to changes in solar irradiance and temperature. Once the

maximum PowerPoint is set up, the CN- 3791 maintains this voltage using a DC/ DC buck-boost motor, which varies its duty cycle to stabilize the panel's operating voltage. The motor also supplies a stable charging current at a suitable voltage for battery charging, icing maximum power birth from the panel. The CN- 3791 labors a constant 4.2 V with a minimum chance query of 1 and requires a minimal input of 4.5 V. This regulation maximizes effectiveness and delivers optimal power to the battery.

Area of Solar Panel, A (m^2) c	Local Solar Irradiance, E (kWh/m^2)	Average Output Voltage, V_{ou} / 3 readings	Average Output Current, A_{ou} / 3 readings	Max Power Output, $Pmax$
0.0132	1571	8.98	0.221	1.98

Due to limited measurement equipment, direct solar irradiance data could not be obtained. Instead, meteorological records for Kuala Lumpur, the study area, were used to estimate irradiance values based on local climatic conditions. The following sources provided the data for our analysis.

From the data we obtained, we calculated the efficiency of our 9V solar panel using the solar efficiency formula. We obtained an approximate of about 9.55%.

$\eta max = Pmax$

$AcE \times 100$

= 1.98

$0.0132 \times 1571 \times 100$

= 9. 55%

The efficiency of the solar panel, as determined through experimental testing, was found to be satisfactory for powering the Bluetooth car prototype. In the circuit design, the solar panel primarily provided a charging voltage to the battery, while the lithium-ion batteries served as the main power source for the car. This setup allowed the solar panel to recharge the batteries simultaneously as the car operated.

6. RESULT

The solar-powered voice-controlled vehicle was successfully developed and operated as intended. Using the MIT App Inventor, we created a custom mobile application that could recognize voice commands and transmit them to the vehicle via Bluetooth.

Upon receiving spoken instructions like "forward", "left", "right", "reverse", and "stop", the vehicle responded almost instantly and navigated accordingly. The system demonstrated smooth communication between the mobile app and the vehicle's microcontroller, ensuring efficient command execution. Importantly, the vehicle operated completely on solar energy, proving the reliability of renewable energy integration with smart control systems. Under direct sunlight, the solar panel provided sufficient power for uninterrupted movement without the need for external charging.

The project not only achieved seamless voice control but also highlighted the eco-friendly potential of combining clean energy with modern IoT technologies. Overall, the system was found to be responsive, sustainable, and user-friendly, offering exciting prospects for future development in green and smart mobility solutions.

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